Inherited Human Traits: A Quick Reference

Abstract

Information about genes, traits, and inheritance that supports student activities in this module. Includes a pictorial reference of inherited human traits used in the module's activities, along with inheritance patterns, frequencies, and other interesting facts about each.

Learning Objectives

- Background information for educators.

Additional Resources

Visit the Learn.Genetics website to get links to great resources like this one! Just login as a teacher, and click on *The Basics and Beyond: An Introduction to Heredity* to download engaging student activities about inherited human traits.

Special Features You'll Find Inside

- Fun facts and background information about common traits used in this module.

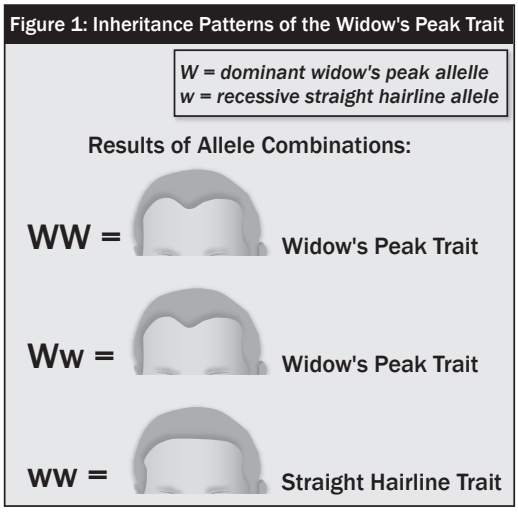
Inherited Human Traits: A Quick Reference

Background Information

Physical traits are observable characteristics determined by specific segments of DNA called genes. Multiple genes are grouped together to form chromosomes, which reside in the nucleus of the cell. Every cell (except eggs and sperm) in an individual's body contains two copies of each gene. This is due to the fact that both mother and father contribute a copy at the time of conception. This original genetic material is copied each time a cell divides so that all cells contain the same DNA. Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits.

Most genes have two or more variations, called alleles. For example, the gene for hairline shape has two alleles – widow's peak or straight. An individual may inherit two identical or two different alleles from their parents. When two different alleles are present they interact in specific ways. For the traits included in this activity, the alleles interact in what is called a dominant or a recessive manner. The traits due to dominant alleles are always observed, even when a recessive allele is present. Traits due to recessive alleles are only observed when two recessive alleles are present. For example, the allele for widow's peak is dominant and the allele for straight hairline is recessive.

Figure 1: Inheritance Patterns of the Widow's Peak Trait



If an individual inherits:

- Two widow's peak alleles (both dominant), their hairline will have a peak
- One widow's peak allele (dominant) and one straight hairline allele (recessive), they will have a widow's peak
- Two straight hairline alleles (recessive), their hairline will be straight.

A widespread misconception is that traits due to dominant alleles are the most common in the population. While this is sometimes true, it is not always the case. For example, the allele for Huntington's Disease is dominant, while the allele for not developing this disorder is recessive. At most, only 1 in 20,000 people will get Huntington's; most people have two recessive, normal alleles.

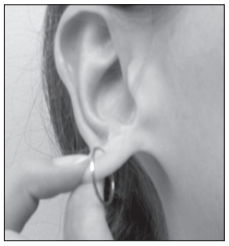
While a few traits are due to only one gene (and its alleles), most human genetic traits are the product of interactions between several genes.

The traits listed on the next pages have commonly been presented as being determined by single genes. However, several have been shown to involve more than one gene, and research studies do not agree on the inheritance patterns of others.

Inherited Human Traits: A Quick Reference

Earlobe Attachment


Attached Earlobes


Detached Earlobes

If earlobes hang free, they are detached. If they attach directly to the side of the head, they are attached earlobes.

Some scientists have reported that this trait is due to a single gene for which unattached earlobes is dominant and attached earlobes is recessive. Other scientists have reported that this trait is probably due to several genes.

The size and appearance of the lobes are also inherited traits.

Tongue Rolling


Can Roll Tongue


Can't Roll Tongue

In 1940, the famous geneticist Alfred Sturtevant noted that about 70% of people of European ancestry are able to roll up the lateral edges of the tongue, while the remaining 30% were unable to do so.

Tongue rolling ability may be due to a single gene with the ability to roll the tongue a dominant trait and the lack of tongue rolling ability a recessive trait. However, there is some question about the inheritance of tongue rolling. Recent studies have shown that around 30% of identical twins do not share the trait.

Cleft Chin

This trait is reportedly due to a single gene with a cleft chin dominant and a smooth chin recessive.

Inherited Human Traits: A Quick Reference

Dimples

Dimples

Dimples are reportedly due to a single gene with dimples dominant (people may exhibit a dimple on only one side of the face) and a lack of dimples recessive.

Handedness

Some scientists have reported that handedness is due to a single gene with right handedness dominant and left handedness recessive. However, other scientists have reported that the interaction of two genes is responsible for this trait.

Freckles

This trait is reportedly due to a single gene; the presence of freckles is dominant, the absence of freckles is recessive[1].

Naturally Curly Hair

Early geneticists reported that curly hair was dominant and straight hair was recessive. More recent scientists believe that more than one gene may be involved.

Allergies

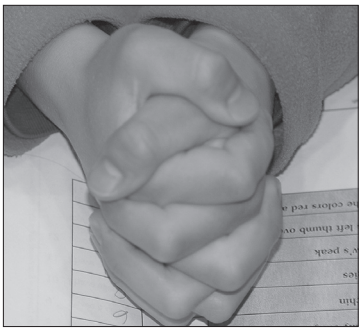
While allergic reactions are induced by things a person comes in contact with, such as dust, particular foods, and pollen, the tendency to have allergies is inherited. If a parent has allergies, there is a one in four (25%) chance that their child will also have allergy problems. This risk increases if both parents have allergies[2].

[1] Rostand, J and Tétry, A . *An Atlas of Human Genetics* (1964) Hutchinson Scientific & Technical, London.
[2] "All About Allergies", The Nemours Foundation (http://kidshealth.org/parent/medical/allergies/allergy_p2.h

Inherited Human Traits: A Quick Reference

Hand Clasping

Cross Left Thumb Over Right



Cross Right Thumb Over Left

Fold your hands together by interlocking your fingers without thinking about it. Which thumb is on top – your left or your right?

One study found that 55% of people place their left thumb on top, 45% place their right thumb on top and 1% have no preference.

A study of identical twins concluded that hand clasping has at least some genetic component. However, other scientists have not found evidence that genetics plays a significant role in determining this trait.

Colorblindness

Colorblindness is due to a recessive allele located on the X chromosome. Women have two X chromosomes, one of which usually carries the allele for normal color vision. Therefore, few women are colorblind. Men only have one X chromosome, so if they carry the allele for colorblindness, they will exhibit this trait. Thus, colorblindness is seen more frequently in men than in women.

Hairline Shape

Widow's Peak Hairline

Straight Hairline

Hairline shape is reportedly due to a single gene with a widow's peak dominant and a straight hairline recessive.

PTC Tasting

Does Not Taste PTC

Tastes PTC

For some people the chemical phenylthiocarbamide (PTC) tastes very bitter. For others, it is tasteless.

The ability to taste PTC shows dominant inheritance and is controlled by a gene on chromosomes 7. This gene codes for part of the bitter taste receptor in tongue cells. One of its five alleles (forms) causes a lack of ability to sense bitter tastes; the other four alleles produce intermediate to fully sensitive taste abilities. Approximately 75% of people can taste PTC while the remaining 25% cannot.

PTC-like chemicals are found in the Brassica family of vegetables, such as cabbage, brussels sprouts, and broccoli. People who can taste PTC often do not enjoy eating these vegetables, since they taste bitter to them. Non-tasters tend not to notice bitter tastes and therefore may be more likely to become addicted to nicotine (which is bitter).

PTC-tasting ability has also provided information related to human evolution. Populations in Sub-Sahara Africa, and people who are descended from this area, contain at least five forms of the gene. Some of these forms confer a PTC-tasting ability that is intermediate between taster and non-taster. However, with only a few exceptions, only two forms – taster and non-taster – are found in populations outside of Africa and their descendents. This is consistent with the out-of-Africa hypothesis of modern human origins.

Some scientists think that tasters have fewer cavities, suggesting that there might be a substance in the saliva of tasters that inhibits the bacteria that cause cavities to form. Others think that PTC tasting may be in some way connected with thyroid function.

PTC tasting was a chance discovery in 1931.

Credits

Unless otherwise noted, all information is from Online Mendelian Inheritance in Man (www.ncbi.nlm.nih.gov/omim/)

Created by:
Louisa Stark, Genetic Science Learning Center
Molly Malone, Genetic Science Learning Center
Harmony Starr, Genetic Science Learning Center
Harmony Starr, Genetic Science Learning Center (illustrations)

Funding

A Howard Hughes Medical Institute Precollege Science Education Initiative for Biomedical Research Institutions Award (Grant 51000125).

Funding for significant revisions:
Grant U33MC00157 from the Health Resources and Services Administration, Maternal and Child Health Bureau, Genetic Services Branch. Partners in the Consumer Genetics Education Network (CGEN) include HRSA, March of Dimes, Dominican Women's Development Center, Charles B. Wang Community Health Center, Genetic Science Learning Center at University of Utah, Utah Department of Health and the National Human Genome Center at Howard University.